The effect of age and level of education on intelligibility

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THE EFFECT OF AGE AND LEVEL OF EDUCATION ON INTELLIGIBILITY

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Abstract

Many factors influencing intelligibility have been uncovered in previous research (Bø, 1978; Gooskens, 2006; Jörgensen & Kärrlander, 2001). However, in intelligibility research, the effect of age has not been investigated as extensively. Apart from Vanhove's (2014) investigation of the effect of age on cognate guessing, almost no other studies have paid attention to this factor. Also, in intelligibility research, the effect of educational level on intelligibility is often neglected as most studies only test either pre-university or university students. This paper examines the potential effect of age and level of education on intelligibility. In contrast to Vanhove (2014), we looked at text intelligibility instead of cognate recognition. We tested 2760 Danish participants in a written or spoken cloze test in Dutch, English, German or Swedish, where they had to fill gaps in a text. The participants varied in age and educational background. We found that both age and level of education affect intelligibility scores. However, for the spoken cloze test education did not have a significant effect on intelligibility scores for Dutch and Swedish. Additionally, age had no significant effect on age for Dutch as a test language. For education we found that people with a higher level of education perform better on the test than participants with a lower level of education.

Keywords

Intelligibility, age, level of education, Dutch, English, German, Swedish.

Introduction

When two speakers of different languages are able to talk to each other using their own language, while still being able to understand each other, those languages are said to be mutually intelligible. This phenomenon of being able to comprehend one another based on similarities in the languages involved has been referred to by various terms, varying slightly in meaning and perspective, including *receptive multilingualism* (Hockett, 1958), *semi-communication* (Haugen, 1966), *mutual intelligibility*, *receptive bilingualism* and

intercomprehension (Vanhove, 2014). Mutual intelligibility can be *inherent* or *acquired*. It is said to be inherent when people are able to understand another language on the basis of linguistic similarities between their mother tongue and the other language. Acquired receptive multilingualism, on the other hand, occurs when one or both communication partners have learned to understand the other language and are therefore able to communicate with others using that language by means of receptive multilingualism (Bahtina & ten Thije, 2012).

Research into mutual intelligibility started in the 1950's. The first line of research was mainly concerned with a variety of Native-American languages (Hickerton, Turner & Hickerton, 1952; Pierce, 1952; Wolff, 1959). Later, research also focused on European languages (Budovičová, 1987; Berger, 2003; Jensen, 1989). A well-known example where receptive multilingualism is used is Scandinavia. The Scandinavian governments have actively promoted this form of multilingualism by, for example, emphasising the importance of using the Nordic languages instead of a lingua franca while communicating with their Scandinavian neighbours (Nordic council, 1987). Also TV-shows such as *The Bridge*, that use receptive multilingualism, have contributed to this promotion. The Bridge revolves around a body that is found on the bridge between Copenhagen and Malmö. The Danish and Swedish police need to work together in order find the killer. They do so whilst both speaking their own language yet they succeed and solve the crime.

Since receptive multilingualism is a common way of communicating in Scandinavia, a great amount of research has been carried out concerning this matter. One of the first to investigate the mutual intelligibility of Scandinavians was Haugen (1953; 1966). He measured mutual intelligibility by means of self-reports in which people had to indicate how well they could understand their neighbouring Scandinavians. Haugen found that Norwegians claimed to "understand" the neighbouring languages best whereas Swedes understood least of the neighbouring languages. Since this method is rather subjective, as it relies on self-ratings and not on objective tests, Maurud (1976a, 1976b) decided to look at mutual intelligibility in a more experimental setting. He used a word translation task combined with questions and found that Danes and Norwegians understood each other to the same extent in both written and spoken language. Danes and Swedes understood each other equally well in written language, but the Danes were better able to understand spoken Swedish than vice versa. Lastly, Norwegians and Swedes understood each other equally well in written language, but for spoken language Norwegians were better at understanding Swedish than the other way around. The studies conducted by Haugen and Maurud focussed mainly on measuring the intelligibility. Later research focused on uncovering the factors that influence differences in mutual intelligibility. This research mainly revolves around four such influencing factors: exposure (Maurud, 1976b; Bø, 1978; Jörgensen & Kärrlander, 2001; Lundin & Zola Christensen, 2001; Delsing & Lundin Åkesson, 2005; and Gooskens, 2006; 2007), attitudes (Kuhlemeier, van den Bergh & Melse, 1996; Jörgensen & Kärrlander, 2001; Lundin & Zola Christensen, 2001; Delsing & Lundin Åkesson, 2005; Gooskens, 2006; Gooskens, 2007; Gooskens, van Bezooijen & van Heuven, 2015; Gooskens et al., submitted), lexical differences (van Bezooijen & Gooskens, 2005; Gooskens & van Bezooijen, 2006; Gooskens & van Bezooijen, 2007; Gooskens et al., 2015) and phonetic differences (Kürschner, van Bezooijen & Gooskens, 2008; Doetjes & Gooskens, 2009; Gooskens, van Heuven, van Bezooijen & Pacilly, 2010; Schüppert, 2011; Hilton, Gooskens & Schüppert, 2013; Schüppert, Hilton, Gooskens & van Heuven, 2016).

Two factors that have been neglected until now are age and education. Studies on second language development have shown that intelligence influences language learning (cf. Paradis, 2011; DeThorne & Watkins, 2006; Tellegen, Winkel, Wijnberg-Williams & Laros, 2005; Hickey, 1997; Genesee & Hamayan, 1980). Since intelligence is often associated with level of education, we may assume that level of education also correlates with language learning and mutual intelligibility. Nevertheless, this effect is often not taken into account in intelligibility research.

The same goes for the effect of age. Vanhove (2014) investigated the link between age and intelligibility, measured by means of cognate guessing skills. His results show that cognate guessing skills develop differently in the written and in the spoken modality. Cognate guessing performance increases throughout both childhood and adolescence in the written and spoken modality. In the written modality, the performance even keeps improving slightly throughout the adult lifespan whereas in the spoken modality performance drops appear around age 50. Vanhove accredits this to the fact that the visual mode of presentation enables the participants to use their knowledge to a greater extent than the auditive mode.

There have hardly been any studies investigating the effect of age and level of education on intelligibility. An exception is Vanhove's research. However, while Vanhove's study is restricted to intelligibility at the word level our research focuses on whole texts. Because most studies recruit either pre-university or university students as participants, the age and level of education is similar across and within studies so that it does not permit researchers to draw conclusions about the effect of age and education on intelligibility. As there has hardly been any research investigating the effect of age and level of education on intelligibility scores, we try to fill that gap with our investigation. As a main question we ask what the effect of age and level of education is on intelligibility scores. We hypothesize that both factors exert their influence on the intelligibility scores.

Inter-Scandinavian intelligibility has been very well-documented, because of the large number of studies that have looked into this phenomenon as described above. In our study, we do not only investigate Danish-Swedish intelligibility, but we expand the language combinations with Danish-Dutch, Danish-German and Danish-English. Our study therefore also contributes to the study of cross-Germanic intelligibility, a matter that has not been investigated very extensively before.

Design

This study is part of a larger project called the MICReLa (Mutual Intelligibility of Closely Related Languages) project.[11] The MICReLa research group investigates the mutual intelligibility of closely related languages in Europe and is looking into its linguistic and non-linguistic determinants. In the larger project six different intelligibility tests are used. In this study, however, we report two of these tests: a cloze test with written stimuli and one with spoken stimuli (see Procedure for an explanation of this test). The MICReLa project runs from 2011 until 2016 and there are over sixteen languages included in the research that is being conducted. Yet for this study, we only focus on the intelligibility of Dutch, English, German and Swedish for speakers of Danish. We use data collected by Swarte for her dissertation on mutual intelligibility between Germanic languages (Swarte 2016). In Swarte's

[11] See http://www.let.rug.nl/gooskens/project/

study, age and level of education were not included, therefore this study provided a complement to her dissertation.

Method

Intelligibility was tested by means of a cloze test with written stimuli and one with spoken stimuli. Four texts were used for this task which were selected from a set of exercises used at the University of Cambridge to prepare students for the Preliminary English Test (PET). These texts were all designed for B2/B1 level according to the Common European Framework of Reference for Languages (CELR, 2002). The texts each contained sixteen or seventeen sentences and had a length that varied between 189 and 245 words. Since Danish, Dutch, German and Swedish are also part of the study, three native speakers per language translated the English texts into those languages. One translator translated the text and the two other translators corrected the first translation if this was necessary. All translators were between 20 and 40 years old, had university education and had a sufficient level of English. For the spoken version of the cloze test, four female native speakers of each language recorded the texts. Only female voices were recorded to exclude any possible effect of gender of the speaker. In the cloze test, participants had to read or listen to a text. From every text twelve words (four adjectives, four nouns and four verbs) were removed and replaced by gaps of equal lengths (in the written cloze test) or beeps (in the spoken cloze test).

In the written cloze test, the deleted words were listed above the text. The words were presented in the test language, but a translation into the native language could be seen by moving the cursor over a word. The translations were included because the intelligibility of individual words are not of interest to the study: the focus is on the understanding of the text as a whole. The participants had to drag each word to the correct gap in the text. They were told that each word had to be used once. However, if they thought they had dragged a word to a wrong gap they could move it to another one later.

In the spoken cloze test, the text was split up into twelve sound fragments, in which one word was replaced by a beep. Each fragment was played twice. For each fragment, the participants had to choose the word that should be in the place of the beep from a list of the twelve removed words. They had thirty seconds to make a choice. Participants were told that each word was supposed to be used once, but if they realised they had made a mistake they could use a word again.

Procedure

The data was gathered using an online application (see www.micrela.nl/app). Before starting the actual test each participant first completed a list with background questions. These questions covered topics such as age, sex, level of education, country of growing up and country where the participant spent most of their life. This included the region and the number of years spent there. Also, a number of questions on exposure and attitudes were included, which are not relevant in the context of this study.

After having finished the lists with the background questions, the participants were presented with an intelligibility experiment in a related language. This could be either a version of the spoken or the written cloze test. The mode and the language the experiment was to be taken in, were randomly assigned to the participants.

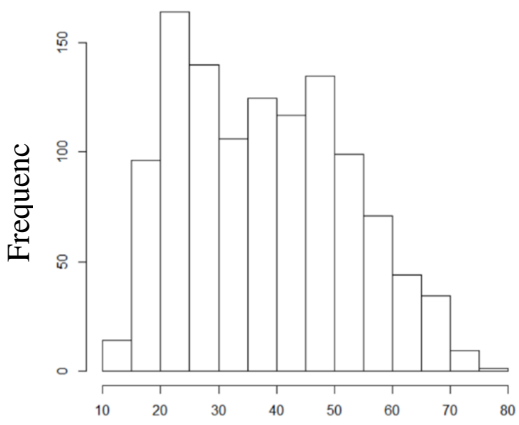
Participant selection

Recruitment of the participants mainly came about through Facebook, online newspapers and university mailing lists. In total, 2,760 Danish participants (1,075 female and 1,649 male) took either the spoken or the written cloze test in one of the four related languages (Dutch, English, German or Swedish). These participants were divided into groups according to the related language they were confronted with (for this study Dutch, English, German or Swedish), the test they took (written or spoken cloze test) and their level of education (low, secondary, vocational and university education) (cf. Table 1 and Table 2). The group that took the spoken cloze test and the group that took the written cloze test were distributed equally in terms of age and education. Table 1 shows how many Danish participants took each test in which language.

Table 1. *Number of Danish participants that took each test in the different languages.*

Language	Total number of participants	Number of participants for the written cloze test	Number of participants for the spoken cloze test
Dutch	617	391	226
English	735	383	352
German	637	402	235
Swedish	744	430	314
Total	2760	1606	1154

In this study only participants who indicated they have received some sort of education were included. This choice was made because it seems highly unlikely a person has not received any education at all, the background info relying solely on self-report. In addition to the people without an education, we excluded participants over 80 years of age because their number was low and not evenly distributed across the experiment types (written versus spoken). Finally there was one participant who was very young, 10 years old, who was an outlier and therefore also removed from the study. The mean age of all participants was 39. The distribution of the age of the participants is visualised in Figures 1 and 2. Both figures show a slight positive distribution of age. This means that there were slightly more younger people in our sample than older people.



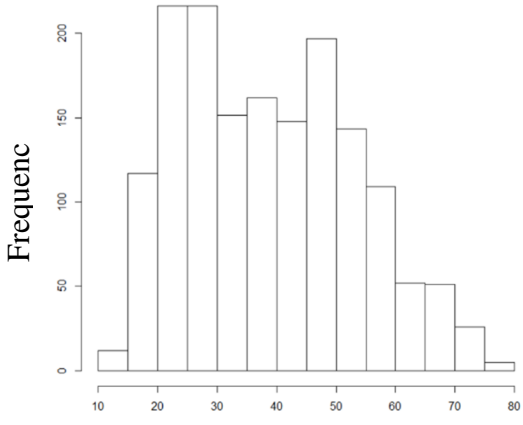


Figure 1. Distribution of age amongst participants who took the spoken cloze test.

Figure 2. Distribution of age amongst participants who took the written cloze test.

The participants had four different levels of education: lower education, secondary education, vocational education and university education. Table 2 shows the distribution across these levels.

Table 2. Number of Danish participants per educational level per test.

Level of education	**Total number of participants**	**Number of participants for the written cloze test**	**Number of participants for the spoken cloze test**
Lower education	226	133	93
Secondary education	420	231	189
Vocational education	1188	684	504
University education	926	558	368
Total	2760	1606	1154

Results

A logistic regression analysis was performed using R (version 3.2.2) to investigate the effect of age and level of education on spoken and written cloze test scores. In this model, the dependent variable is categorical and can only take two values: for our model a correct solution or an incorrect solution. The effect of age and level of education on spoken and written cloze test scores is measured by estimating probabilities using a logistic function. This entails that, for example, if a coefficient of 0.078 is found, for every increase with one in that variable the log odds are that y = 1 increases with 0.078.

The effect of age and level of education on the intelligibility scores for the spoken cloze test

A logistic regression was performed to determine the effect of age and level of education on spoken cloze test scores. The results of the logistic regression show that the model fits the data very well as the results were significant ($p < .001$) and that it explained 60.1% (Nagelkerke R^2) of the variance in the scores. For German and English the higher the level of education, the higher the score is. For Dutch and Swedish the level of education has no significant effect on intelligibility scores. For all languages except Dutch, age has a significant effect on intelligibility scores. This is illustrated in Table 3. The non-linear interaction between age and level of education was not significant.

Table 3. p-values for the spoken cloze test.

Language	Age	Education
Dutch	0.261	0.062
English	< .001	< .001
German	< .001	< .001
Swedish	< .001	0.762

Age

Figure 3 shows the age of the participants set against the log odds of getting the answer on the spoken cloze test correct. For German we see that participants seem to improve until their early sixties after which their chances of a good performance declines a little only to rise in throughout the first half of their sixties and drop after the second half of their sixties and into their seventies. For English we see that the young participants have the best chance to perform well and that this decreases slowly as they age with a steep decline from their sixties onward. Participants taking the test in Dutch did not obtain a high score at any point in time and there are no significant differences between ages. For Swedish we see that participants keep improving until they are in their thirties. After this they remain stable until their sixties which marks a decline. However, in their seventies their chance of a good performance increases again. An important note to be made here is that this increase is based on only four participants and must therefore be interpreted with caution. These results are not fully compatible with Vanhove's (2014) findings. He found that in the spoken modality performance drops appear around age fifty. Our results are similar in that we also found performance drops in the spoken modality for the participants doing the test in English. However, for the other languages we see not only performance drops but also improvements in performance.

Level of education

Figure 4 shows the level of education of the participants set against the log odds of getting the answer on the spoken cloze test correct. For German we see that a higher education results in a higher chance of a good performance on the spoken cloze test. The same goes for English although this line is less steep. For English it appears that a lower education will yield a higher change of a good performance than in German. For Dutch and Swedish a higher

education does not result in a higher chance of a good performance on the spoken cloze test as the test was not significant for these languages.

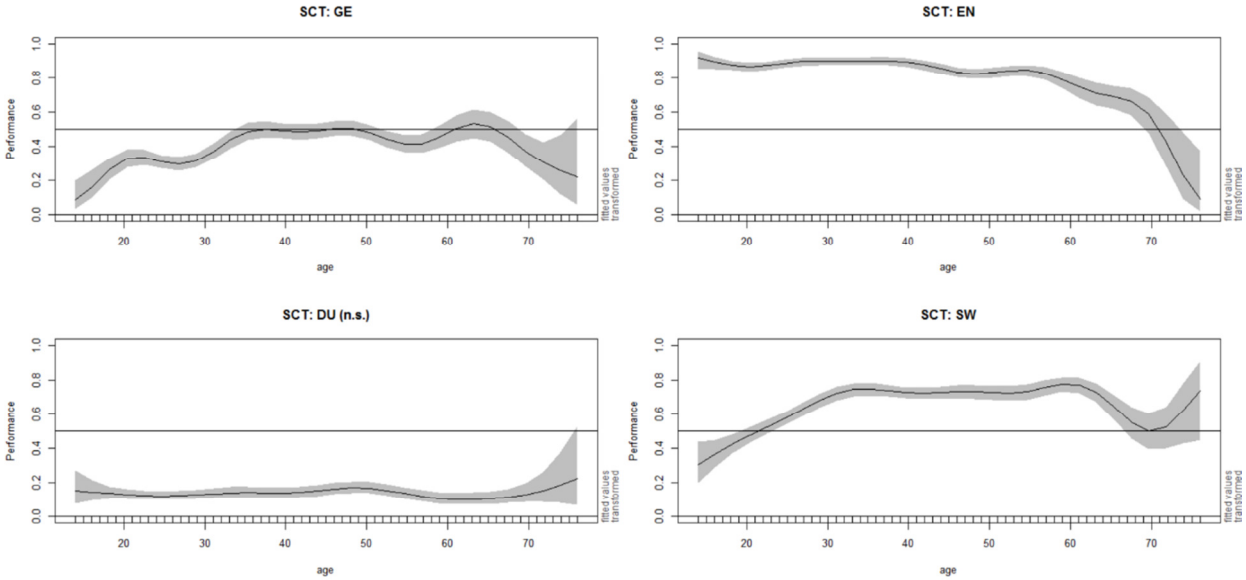


Figure 3. Chance of good performance of all languages and ages. SCT = spoken cloze test; GE = German; EN = English; DU = Dutch; SW = Swedish.

The effect of age and level of education on the intelligibility scores for the written cloze test

Another logistic regression was performed to establish the effect of age and level of education on written cloze test scores. The results show that the model was highly significant ($p < .001$) and that it explained 52.7% (Nagelkerke R^2) of the variance in the scores. For all languages, the level of education has a significant effect on intelligibility scores: the higher the level of education the higher the score is. Additionally for all languages age has a significant effect on intelligibility scores. This is illustrated in Table 4 below. The non-linear interaction between age and level of education was not significant.

Table 4. *p-values for the written cloze test.*

Language	Age	Education
Dutch	< .001	< .001
English	< .001	< .001
German	< .001	< .001
Swedish	< .001	< .001

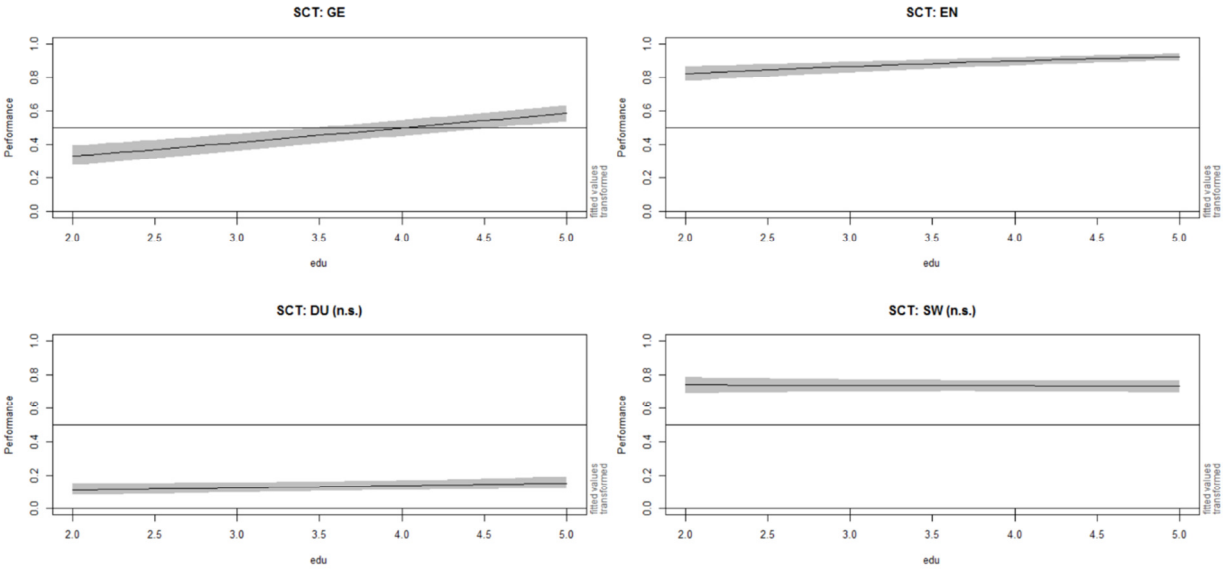


Figure 4. Chance of good performance of all languages and levels of education. SCT = spoken cloze test; edu = level of education; 2 = lower education; 3 = secondary education; 4 = vocational education; 5 = university education.

Age

Figure 5 shows the age of the participants plotted against the log odds of getting the answer on the spoken cloze test correct. For German we see the chance of a good performance seem to drop until participants are 20 years old, but we must interpret this with caution as there are relatively few participants of these ages making the prediction less trustworthy. From 20 until to 35 years of age performance chance stays similar only to increase from 35 onward until halfway through participants' forties. Again performance chances stay similar with a little drop around 60. From participants' seventies onward performance changes drop rapidly. Looking at English we see that young participants are rapidly improving until their twenties (again this must be interpreted with caution) after which performance chance stays stable until participants are approximately 65 years of age, after this age performances drop. Similarly to the spoken cloze test, the performances in Dutch do not differ a lot between the different ages although the pattern shows a slight increase in performance between 30 and 40 years of age. After this we see a gradual decrease in performance. The pattern seen in Swedish is similar to that seen in English: young participants are rapidly improving until they are approximately 25 year old after which performance chance stays stable until participants are approximately 70 years of age, after which performances drop. Again, these results are not in line with Vanhove's (2014) findings: he found that in the written modality performance keeps improving slightly throughout the adult lifespan. We did not see such an improvement but, rather, performance drops in the written modality when participants reached the age of about 65 (for Dutch this drop started at the age of 40). Therefore our results are more compatible with Vanhove's findings for the spoken cloze test in which he found performance drops appear around age 50.

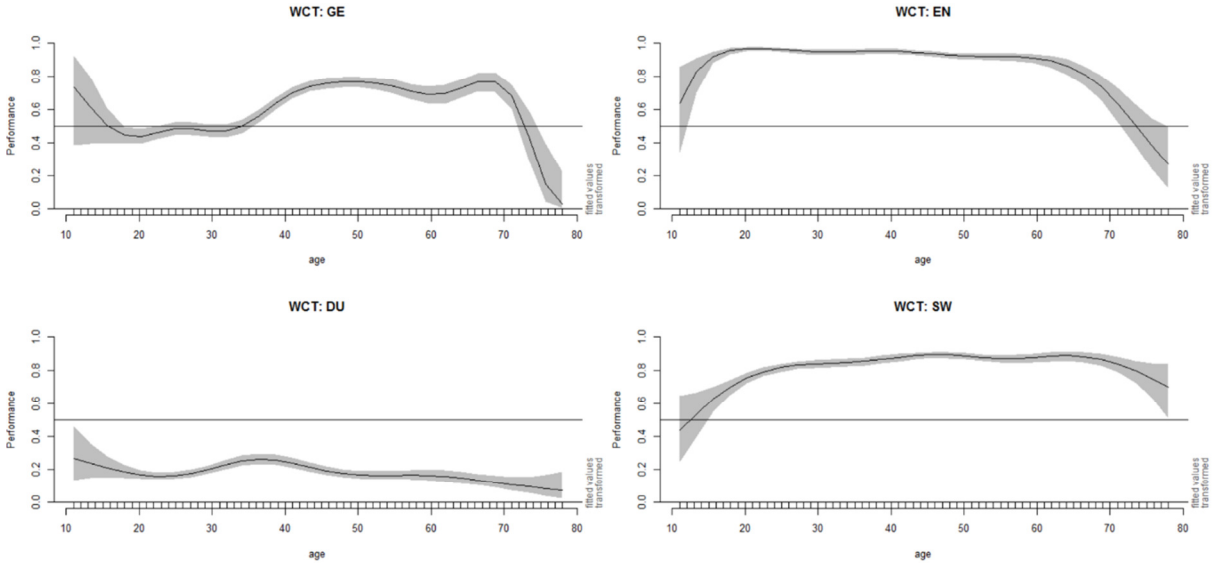


Figure 5. Chance of good performance of all languages and ages. WCT = written cloze test; GE = German; EN = English; DU = Dutch; SW = Swedish.

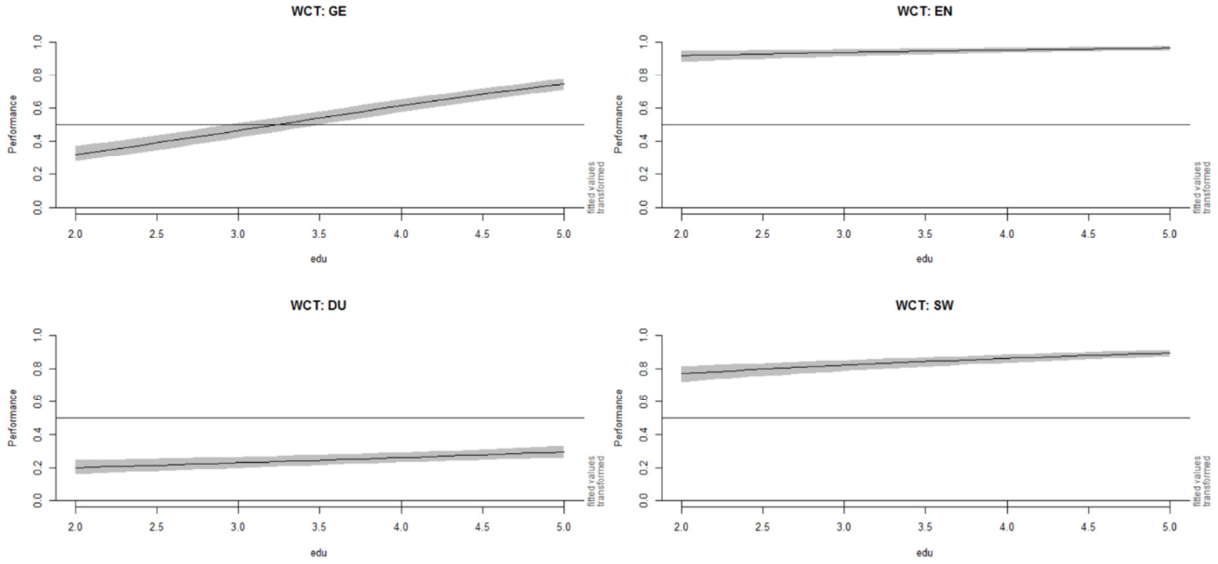


Figure 6. Chance of good performance of all languages and levels of education. WCT = written cloze test; edu = level of education; 2 = lower education; 3 = secondary education; 4 = vocational education; 5 = university education.

Level of education

Figure 6 shows the level of education of the participants set against the log odds of getting the answer on the spoken cloze test correct. As mentioned before, higher education results in a

higher chance of a good performance on the written cloze test in all languages. The only difference in results across the languages is the steepness of the line, that is how much better the chance of a good performance is. For German the line is quite steep whereas it is not for Dutch and English: for people taking the test in English even a lower education appears to yield a good chance of a good performance. In Dutch however, even a university education does not seem to yield a very good chance of a good performance on the written cloze test. For participants taking the test in Swedish the chance of a good performance appears to lie between German on the one side and Dutch and English on the other side.

Conclusion and discussion

In this study we investigated two factors that might have an effect on intelligibility: age and level of education. We found that both age and level of education affect intelligibility scores. However, for the spoken cloze test education did not have a significant effect on intelligibility scores for Dutch and Swedish. Additionally, age had no significant effect on intelligibility for Dutch. For education we found that people with a higher level of education perform better on the test than participants with a lower level of education. This finding is in line with the literature as different studies showed that intelligence influences (bilingual) language development (cf. Paradis, 2011; DeThorne & Watkins, 2006; Tellegen et al., 2005; Hickey, 1997; Genesee & Hamayan, 1980). Although these studies focused on children's language development, we might assume that they can also be generalised to adults. The research conducted by Genesee and Hamayan (1980) showed that cognitive skills were important in predicting individual differences in kindergarten children who acquired French as an L2. More recent research by Paradis (2011) confirmed these results. She found that in children learning English as an L2, analytic reasoning was a significant predictor for vocabulary as well as for verb morphology. Unfortunately the results for age are not as easy to summarise as the results for education were. We found the performance with different ages to vary across languages and across the spoken and written modality. We did not find a significant interaction between age and level of education.

Our model described a large part of the variance in the data: 60.1% and 52.7% for the spoken and written cloze test respectively. Overall the participants performed better on the written cloze test than on the spoken cloze test. This is a logical finding as one can better hold on to various components of language (such as words) when they are presented within a context.

As already mentioned in the Results section, our results are not similar to findings by Vanhove (2014). The only similarity we found is that we found performance drops in the spoken modality for the participants doing the test in English. However, for the other languages we see not only performance chance drops but also improvements in performance chance. As we found performance drops with older age in the written cloze test our results are also not compatible with Vanhove's for the written modality as he found a slight increase across the adult life span. These different findings for the written modality might be due to the type of test used. Vanhove used a cognate guessing task whereas we tested on the text level by means of a cloze test. The reason that different tests might account for the different findings might be that context plays an important role. As mentioned before: one can better hold on to various components of language (such as words) when they are presented within a context. An explanation as to why the results for the spoken modality differ could be that the

older participants had decreased hearing abilities and this has a larger effect on word recognition than on the understanding of an entire text.

The results of our study shed light on two variables for text intelligibility. From our findings we can conclude that both age and level of education affect text intelligibility. Since our research is one of the first to look into the link between these variables, a suggestion for future research can be to include other language pairs, like for example Romance or Slavic languages, and test types. However, the effect of age and level of education on intelligibility should not be overestimated as other variables found to affect intelligibility in earlier studies, like exposure (e.g. Maurud, 1976b), attitudes (e.g. Kuhlemeier et al., 1996), lexicon (e.g. van Bezooijen & Gooskens, 2005) and phonetics (e.g. Kürschner et al., 2008), can be considered to be important predictors of intelligibility. Therefore, another suggestion for further research would be to add age and level of education to a model such as the one used in Swarte (2016) where all these factors are included. This will paint a more complete picture of intelligibility as there is bound to be covariance between different variables, which might reduce the influence of age and level of education.

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